CHAPTER 3
AIR COMPRESSORS

3-1. Application.

Whenever it is economically feasible, a central compressed air system will be utilized to serve multiple points of use. The air pressure in the receiver will be in the range of 80 to 125 pounds per square inch guage (psig). Compressors and all accessories will conform to American Society of Mechanical Engineers (ASME) B19.l and B19.3, ASME Boiler and Pressure Vessel Code Section VIII, PTC-9 & PTC-10, and Instrument Society of America (ISA) S7.3, as applicable. Oxygen must not be handled in the presence of hydrocarbon lubricants. Where lubricating oils cannot be tolerated at the point of use, oil-free air compressors will be used. Oil-free air is required for such end uses as food handling, medical and dental applications (consult TM 5-838-2 or AFR 88-50, as applicable, and NFPA 99), chemical processing, and instrument air for pneumatic controls. Oil-free air can be obtained by using a centrifugal compressor, which is not lubricated due to its configuration; a water-sealed rotary compressor: or a reciprocating nonlubricated air compressor using carbon or Teflon for piston and packing rings. For isolated cases where oil-free air is required on a compressed air system coalescing filters may be used to remove solids, moisture, and oil from the air stream.

3-2. Types.

An analysis will be made for each compressor selection to insure that the best value is obtained. Comparisons of such items including, but not limited to, brake horsepower (bhp) per 100 cubic feet per minute (cfm), unloaded horsepower, expected compressor life, and expected operation and maintenance costs, should be made between the different types of compressors before final selection is made. The following basic types are available:

a. Reciprocating. Air volumes range up to approximately 6,000 cfm. The need for shielding or baffling structures around the reciprocating compressor to meet noise attenuation requirements requires investigation. These positive displacement compressors are available with oil-lubricated and oil-free cylinders.

b. Liquid sealed rotary. This type of unit provides oil-free, positive displacement. non-pulsating operation. The compressors will have enclosed rotors with conical porting for adjustment of internal clearance. Air volumes range from 50 cfm to approximately 300 cfm. This type of air compressor is recommended for health care facilities.

c. Rotary helical screw. Oil lubricated rotary helical screw compressors have an air volume range from 22 to 3,100 cfm. This type of compressor serves best as a baseload machine. Oil-free rotary helical screw compressors have an air volume range from 400 to 12,000 cfm. Another type of rotary compressor, the oil-free rotary lobe compressor is available from 100 to 500 cfm. Oil-free rotary screw and rotary lobe compressors can be used for baseload or partial load.

d. Rotary sliding vane. Air volumes range up to approximately 3,000 cfm. Such compressors can be oil-injected, oil-flooded, or oil-free types. This type of compressor has low operating cost, no pulsation, and is free from vibration. This permits installing the compressor directly on the simplest foundation.

e. Centrifugal. Air volumes range from approximately 1 .200 cfm to approximately 18,000 cfm. A blowoff silencer is needed for noise control. Centrifugal compressors require no lubrication in contact with the airstream and therefore provide oil-free air.

f. Tank-mounted compressor. A considerable field problem has been experienced with tank rupture at the weldment points. To alleviate the potential problems of tank rupture at weldment points, tank-mounted air compressors are required to be factory-assembled units with tanks constructed in accordance with ASME Boiler and Pressure Vessel Code Section VIII.

3-3. Capacity.

Total air requirement will not be based upon the total of individual maximum requirements, but upon the sum of the average air consumption of air operated devices. Determination of the average air consumption is based on the concept of load factor (the ratio of actual air consumption to the maximum continuous full-loaded air consumption). The Compressed Air and Gas Institute (CAGI) Compressed Air and Gas Handbook explains the procedure for using load factor to determine compressor capacity. After making the calculation, add 10 percent to the estimated consumption for leakage. The total is the compressor capacity required for design. More capacity may be added to allow for future growth of the facility or serviced area over the next 2 years.

3-4. Multistaging.

Multistage compression can be used to reduce power losses associated with the air temperature rise during compression. Also, compression efficiency will be increased using multistaging. The air compressor unit, however, will increase in cost and will be a more complicated machine. Before selecting compressor staging, an economic evaluation should be performed with consideration given to the required air pressure levels and the intended compressor use. When using multistage compression, intercoolers should always be used to improve the efficiency of the air compressor unit.

3-5. Number.

An economic evaluation is necessary to determine whether a central compressed air distribution system or a system of separate compressors located near the point of usage is most cost-effective. Selection of the number of compressors for either situation should be based upon economics and other factors such as system reliability. Seasonal or operational load variations must also be considered. The efficiency of larger compressors is generally higher than that of smaller units, but use of smaller air-cooled units permits savings on water, water piping, and system losses. Multiple units with interconnecting piping give flexibility for maintenance shutdown of one compressor. A smaller air compressor to handle requirements for weekends, holidays, and other low usage times may also be economical.

3-6. Location.
Compressors are to be located in clean, well lighted, and ventilated areas of sufficient size to permit easy access for cleaning, inspection, and any necessary dismantling, such as removal of pistons, wheels, crankshafts, intercoolers, motors, and drivers. Adequate aisle space is needed between items of equipment for normal maintenance as well as for equipment removal and replacement.

3-7. Automatic warning and shutdown.

Air compressor systems will be protected against high temperature, high pressure, low oil pressure, and in the case of centrifugal compressors, excessive vibration. Protective controls will include a fault indicator and a manual reset device.

3-8. Vibration limits.
Compressor manufacturers should be contacted to obtain guidance for establishing representative centrifugal compressor vibration levels.

3-9. Lubrication system.
System design will be in accordance with the manufacturer's recommendations. Lubricant type will depend on the compressor application:

a. Gravity, splash, or pressure petroleum oil will be used where oil contamination of the compressed air at the point of use is not a problem.

b. Synthetic liquid lubricants will be used where there is a danger of fire, where the carbonaceous deposits must be reduced, or where lubricant is provided for extended maintenance periods.

c. Solid lubricants, such as carbon or Teflon piston rings, will be used for oil-free reciprocating compressed air applications.

3-10. Control systems.
Energy can be conserved with a combination of pneumatic cylinder unloading and a manual-off-automatic selector switch on the compressor. When in the manual position, the compressor loads and unloads to meet compressed air demands. In the automatic position. a time delay relay allows the compressor to operate for a predetermined length of time unloaded, and then stops the unit. An air demand will again start the unit, when needed. For multiple compressor systems, the automatic start/stop sequence should alternate among all compressors.

3-11. Sound tests.
After installation, a sound test must be performed on all compressors and accessories. Sound reading test results must not exceed limitations set by OSHA Standard *1910.95*. Measurement of sound emitted from installed and operating air compressors will be in accordance with CAGI Compressed Air and Gas Handbook, Appendix B, "CAGI Pneurop Test Code for the Measurement of Sound from Pneumatic Equipment."